

BOTANICAL SURVEY MEMOIR No. 33

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THE VEGETATION OF THE
DISTRICTS OF EAST LONDON
AND KING WILLIAM'S TOWN
CAPE PROVINCE

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THE VEGETATION OF THE DISTRICTS OF EAST LONDON AND KING WILLIAM'S TOWN, CAPE PROVINCE

(With 11 illustrations and vegetation map)

By

D. M. COMINS, M.Sc.

Formerly Botanical Survey Officer

1962

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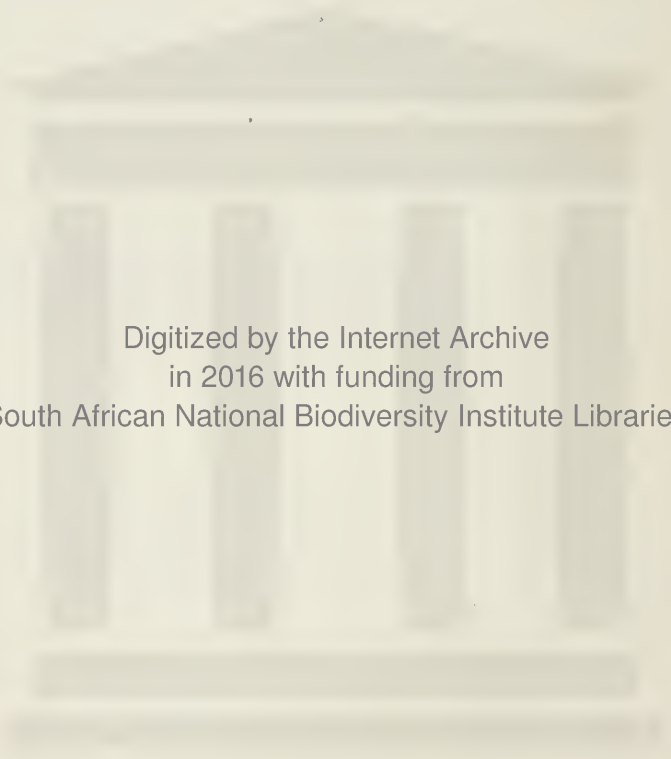
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FOREWORD

The Buffalo Catchment Association—a voluntary organisation representative of municipalities, commerce, industry and agriculture in the districts of East London and King William's Town—approached Rhodes University in 1953 with the request that the University should undertake a comprehensive regional survey of the Buffalo River basin. The survey was subsequently enlarged to include the whole of the districts of East London and King William's Town and the scope of the survey embraced the study of the Natural Resources, Geography, and the Economic and Social Structure within the two districts.

In November, 1954, the Senate and Council of Rhodes University approved the establishment of an Institute of Social and Economic Research at the University as a centre for research within the Eastern Cape, the Ciskei and the Transkei. The Division of Botany of the Department of Agricultural Technical Services was approached and agreed to co-operate with the Institute of Social and Economic Research in this project. In January, 1955, Mr. D. M. Comins was detailed to undertake the botanical section of the survey of the Natural Resources. The following account of the Vegetation of the Districts of East London and King William's Town is the outcome of this collaboration.

R. A. DYER,

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Botanical Survey.*

I.—INTRODUCTION

Work on this botanical survey began when the author assumed the duties of Officer-in-Charge of the Grahamstown Botanic Station and Honorary Curator of the Albany Museum Herbarium in July, 1955.

The survey area lies between 32° 33' and 33° 17' south latitude and 27° 08' and 28° 10' east longitude. At its widest extent it is 60 miles from east to west and 52 miles from north to south. The area is computed to be 1,547 square miles. The precise boundaries may be elucidated by reference to the vegetation map. The western, and much of the eastern boundary, is based on natural features (the Keiskamma River, Kwenxura and Gonubie Rivers). The northern boundary is aligned along cadastral survey lines (with the exception of the section of the boundary which follows the course of the Kubusi River).

Owing to the relatively large size of the survey area the scope of the botanical survey had to be confined to a broad rather than intensive study of the vegetation. Analysis of the stages in the plant succession was based on observation and inference. Specimens were collected and the composition and distribution of the vegetation pattern was studied. Specimens were named at the Albany Museum and duplicates were forwarded to the National Herbarium for confirmation of the identification.

With reference to the map, it should be understood that boundaries between vegetation types are mostly approximate because sharply defined boundaries rarely exist in the field.

ACKNOWLEDGEMENTS

The author has great pleasure in acknowledging his indebtedness to his colleagues and all those who assisted him in various ways. In particular, acknowledgement is made to all the farmers in the survey area for their kindness in supplying information and allowing free access to their properties.

Mr. C.J. Skead, former Director of the Kaffrarian Museum, provided laboratory facilities as well as a wealth of information; without his help and encouragement this survey would never have been completed. Every assistance was received from the Regional Director of Forestry, King William's Town, and the members of his office staff and Forest Officers. The production figures for forests and plantations were extracted and supplied by the Secretary for Forestry, Pretoria. Information with regard to grazing capacities of veld types was supplied by Mr. P. Hildyard of the Dohne Experiment Station and Mr. R. H. Pearde, Extension Officer, East London. The author is indebted to Dr. C. Board, formerly of the Institute of Social and Economic Research, Rhodes University, for assistance in the preparation of the map.

Finally, the author wishes to thank Dr. R. A. Dyer, Chief of the Division of Botany, and Dr. T. H. Barry, Director of the Albany Museum, for all facilities received.

II.—THE VEGETATION

Owing to the dissected terrain and the wide range in altitude within a relatively short distance from the coast to the mountains, the vegetation exhibits a correspondingly wide variation in form and complexity of distribution pattern. The vegetation is composed of two plant formations, namely Woodland and Grassland. Woodland is the dominant component and has replaced Grassland in many localities. Grassland occurs in exposed situations mainly in the midlands. These two plant formations are themselves composed of two floral elements, namely, an eastern component of tropical affinity and an austral component related to the flora of the south-west Cape. The flora is mainly of tropical affinity; the austral component is, by comparison, limited in extent and distribution.

There are eight principal types of Woodland, namely, Riverine Bush, Coast Dune Bush, *Acacia* Woodland (Scrub Type), *Acacia* Woodland (Parkland Type), Scrub, Gully Bush, Dry Forest, and Moist Forest. *Protea* Veld is of minor extent and importance. The Woodland and Grassland communities merge ultimately with four Priseres, namely, the Hydrosere, Lithosere, Halosere, and Psammosere. Moist Forest is the climax community.

In order to understand the relationship of the plant communities and the principles underlying their present extent and distribution pattern, it is necessary to consider them in terms of the facts of plant succession.

Plant succession is the process by which one and the same area is successively occupied by different communities of plants as the vegetation develops. The process is due to biotic reactions and is progressive, the successive stages eventually culminating in a final or climax stage which is determined by the climate. "Succession comprises *change in community, change in species and in life-forms, biotic reactions, and development of the habitat* from an extreme to a *medium or normal condition*" (Phillips, 1934, 566).

The vegetation has been profoundly modified by man, first by the pastoralist Bantu and, to a much greater extent, by the subsequent more intensive exploitation by Bantu and Europeans.

1. THE PRISERES AND THE SUBSERE

The priseres refer to the natural regional succession upon sites undisturbed by man, direct or indirect (Phillips, 1930, quoted by Carpenter, 1938).

The Xerosere

The xerosere is initiated on areas characterised by an extreme paucity of water content. Within the survey area such conditions occur on exposed rock surfaces (the lithosere) and on beach sand (the psammosere).

The Lithosere

Exposed rock surfaces occur on dune rock along the beach and on outcrops of dolerite inland.

The lithosere on dune rock is well represented at Bat's Cave and Cove Rock. The habitat is characterised by extreme exposure to insolation and winds laden with salt spray. Where breakdown of the substrate has resulted in the formation of crevices containing accumulations of sand dwarf forms of *Gazania uniflora*, *Osteospermum fruticosum*, *Cnidium suffruticosum*, and *Delosperma* sp. occur, the plants both short and strongly branched resulting in a mat growth form. In more sheltered situations *Passerina rigida* occurs in association with *Haemanthus albiflos*. The canopy of *Passerina rigida* exhibits a "clipped hedge" appearance due to wind-borne salt spray. On Cove Rock the succession does not show any sign of advance beyond this stage. Elsewhere the *Passerina rigida* zone is invaded by shrub and tree species, such as *Carissa bispinosa*, *Minusops caffra* and *Brachylaena discolor*, to form Coast Dune Bush.

The lithosere on dolerite may be observed on outcrops, particularly on those of southern aspect, throughout the area. On surfaces of northern and north-western aspect, which are exposed to heavy insolation, the sere is initiated by endolithic followed by epilithic crustose lichens. On relatively sheltered surfaces of southern and south-eastern aspect, the sere is initiated by a complex of Myxophyceae in the form of a "skin" which is dark and brittle when dry, green and mucilaginous when wet. The subsequent stage in the succession consists of markedly squamulose foliose lichens (*Lecanora* sp., *Parmelia* sp.) followed by bryophytes (*Polytrichum* sp., *Fimbriaria* sp.) and hepatics (*Riccia* sp., *Marchantia* sp.). The mosses occur as "cushions" and exhibit a remarkable ability to withstand desiccation. Under favourable conditions the above plants build up a litter of detritus which is invaded by xerophytic grasses, such as *Aristida barbicollis*, and geophytes, such as *Scilla paucifolia*. In less arid situations, for example on large boulders in the shade of Forest, the herb stage in the succession consists of dwarf ferns (*Pellaea viridis*, *Pteridium aquilinum*), *Lycopodium gnidioides* (rare), and orchids (*Holothrix orthoceras*, *Stenoglottis fimbriata*).

What may be termed the crevice stage in the succession occurs where weathering of dolerite, along vertical joints, forms crevices in which debris accumulates. These crevices are invaded by herbs, shrubs, and trees, termed chasmophytes, to form Gully Bush. Typical chasmophytes of such situations are *Agapanthus* sp. (Comins, 1951), *Bulbine alöoides*, *Aloe arborescens*, *Encephalartos altensteinii*, and *Maytenus peduncularis*. A well-developed example of this crevice succession occurs at the Yellow Wood Falls.

Another morphological expression of the crevice stage in the succession occurs on dolerite "domes", exposed by erosion, in the vicinity of the road junction to Laing Dam (10 miles from King William's Town on the road to Mount Coke). The crevices have been invaded by a wide variety of shrubs and trees including *Randia rudis*, *Scutia myrtina* (shrub, scrambler or small tree), *Scolopia ecklonii*, *Cussonia spicata*, *Apodytes dimidiata*, *Harpephyllum caffrum*, *Pterocelastrus tricuspidatus*, *Rapanea uelanophloeos*, and *Sideroxylon inerme*. *Randia rudis* and *Scutia myrtina* are heavily grazed by stock and occur as dense "mats" growing flat against the rock surface. The community takes the form of clumps of shrubs and trees, sited on the dolerite outcrops which are scattered in Grassland (Plate I). The community resembles, in many respects, the "bush clumps" which occur on large termite mounds in the Natal thornveld (Bews, 1920). The

seeds of the majority of species appear to be distributed by birds. It is suggested that protection from grass fires afforded to the shrubs and trees (especially when in the young stage of growth) is an ecological factor of some importance.

The crevice stage in the succession is transitional to Gully Bush and Grassland.

The Psammosere

This sere occurs along the beach in unconsolidated sand. The habitat consists of a combination of extremes. The sand substrate, which is devoid of organic matter, is readily transported by wind and tide. Because of rapid drainage and exposure to sun and wind, the upper fraction of the substrate dries readily. A high degree of insolation is combined with strong winds which are charged with salt spray and sand particles. On relatively wide beaches, for example at Cove Rock, the sand-dunes are well developed and lie at right angles to the shore line. The dunes consist of unstable dry sand and have steep leeward slopes.

Pioneer plants are represented by *Scaevola plumieri*, *Ipomoea pes-caprae*, and *Arctotheca nivea*. These plants, by decreasing wind velocity, cause deposition of wind-borne sand. The plants respond by means of rapid lateral growth. In this way hummocks are built up and the unstable dune sand is changed into a relatively stable condition.

The stems of *Scaevola plumieri*, which bear thick fleshy leaves, are borne on a well-developed system of subsurface rhizomes. The fruits are "dispersed widely by currents and locally by birds and the sea" (Muir, 1937, 98). Each seedling, by rapid growth and repeated branching of the rhizomes, eventually gives rise to a plant several square yards in extent. *Ipomoea pes-caprae* has a well-developed system of surface rhizomes (often covered by drift sand) and tough leathery leaves. This plant occurs higher up the beach (relative to positions occupied by *S. plumieri*). *I. pes-caprae* also invades sand-dunes which have been formed by the pioneering of *S. plumieri*, to form an association in which it becomes dominant. The thick prostrate stems of *Arctotheca nivea* bear fleshy leaves which are covered with a tough silvery indumentum. This plant forms relatively small dunes compared with those formed by *Scaevola plumieri* and *Ipomoea pes-caprae*. The stems are not capable of rapid growth and the plants are subject to periodic burial by drift sand. Phillips (1931) states that plants can withstand lengthy burial. The fruits are distributed by wind.

It is noteworthy that the pioneers of this sere, with its extreme habitat features, are members of floristically advanced families and are of tropical affinity.

Where a water-course drains on to the beach, an association of *Juncus acutus*, *Scirpus nodosus*, *Helichrysum velleum*, *Arctotheca nivea*, and *Sporobolus virginicus* occurs; see also Phillips (1931, 123) and Dyer (1937, Fig. 2). An example occurs at Cove Rock.

The communities of the psammosere are invaded by herbs (*Cnidium suffruticosum*, *Carpobrotus edulis*) and shrubs (*Passerina rigida*, *Eugenia capensis*) to form Coast Dune Bush.

The Halosere

The halosere occurs on estuarine flats which are subject to inundation by saline water, for example, at the Keiskamma estuary and at the mouths of the Cefane, Nahoon and Quinira rivers.

The succession is initiated by *Zostera capensis* which occurs sparingly in shallow relatively calm channels in the intertidal zone. MacNae (1957, 126), describing the vegetation of the Zwartkops estuary near Port Elizabeth, states that "the presence of *Zostera* encourages deposition of silt". In the Keiskamma estuary deposits of silt are associated with plants of *Z. capensis*. The flat mud banks of the intertidal zone, where the current is relatively strong (compared with situations where *Z. capensis* occurs), are colonised by *Spartina capensis* which forms extensive meadows (Plate ii).

The plants of *Spartina capensis* form clumps of silt which coalesce with further deposition to form a raised belt of silt intersected by drainage channels. The flats which are formed in this way are subject to exposure and inundation. This belt of *Spartina capensis* is invaded by *Arthrocnemum australasicum* and patches of *Salicornia meyeriana* (Fig. ix). On higher ground *Chenolea diffusa* and *Atriplex halimus* also occur.

The final stage in the succession is represented by *Sporobolus virginicus* which forms a sward extending to higher ground. Judging by the line of debris, it would appear that this sward is subject to occasional flooding. *Stenotaphrum secundatum* may be present above the debris line.

This final stage in the halosere is transitional to Gully Bush or Grassland.

The Hydrosere

The hydrosere occurs in vleis, streams and rivers. There are no extensive marshes within the survey area. It should be noted that the various stages of the hydrosere do not necessarily appear in a regular order: variations occur, particularly in the initial stages of the sere. Depending upon local habitat factors, any one community may be well developed, poorly developed, or absent. The trend is towards a progressive drying-up of the habitat.

The succession may be divided into the following stages:—

The Stage of Submerged and Floating Aquatics

Sphaerotherylax algiformis occurs on rock outcrops in rivers, where it is submerged under rapidly-flowing water. As the water level recedes during drought the plants exposed in the marginal zone die off.

In the calm water of ponds, vleis and dams various rooted submerged aquatics, including members of the Characeae, *Lagarosiphon muscoides*, and *Potamogeton pectinatus*, form consocieties and associates in relatively deep water. These are seral to the following aquatics, which occur in relatively shallow water: *Marsilea macrocarpa*, *Aponogeton kraussianum*, *A. spathaceum*, *Myriophyllum spicatum* (alien, rare), *Isoetes wormaldii* (rare) and *Crassula inanis*. Floating aquatics are in turn seral to the Sedge Meadow Stage.

The Sedge Meadow Stage

The Sedge Meadow Stage (Weaver & Clements, 1929; West, 1951) is equivalent to the Stage of Semi-aquatics of Bews (1920), Phillips (1931), and Dyer (1937).

This stage is characterised by a further reduction in depth of water although there is a good deal of variation, ranging from periodic flooding to a state of damp soil with no surface water.

Typha capensis is an early invader and forms extensive consocieties in water from about six to twelve inches in depth. The Sedge Meadow Stage is characterised by a wide variety of species and a large number of individuals of each species. The Cyperaceae are well represented and include *Cyperus pulcher*, *C. albostrigatus*, *C. esculentus*, *Kyllinga melanosperma*, *Mariscus congestus*, *Scirpus costatus*, *S. cernuus*, *Pycnus polystachyus*, *Fuirena hirta*; other monocotyledons include *Imperata cylindrica*, *Panicum glabrescens*, *P. maximum*, *Kniphofia* sp., *Zantedeschia* sp. (Comins, 1285), *Albuca* sp. (Comins, 1286). Dicotyledons include *Polygonum glutinosum* var. *capense*, *Centella coriacea*, *Matricaria nigellaefolia*, *Ageratum conyzoides*, *Gunnera perpensa*, *Ranunculus pinnatus*, *Venidium arctotoides* and *Denekia capensis*.

In the case of pools and vleis, the Sedge Meadow Stage is seral to Grassland. Mesophytic grasses (*Paspalum dilatatum*, *Andropogon eucomus*, *A. appendiculatus*) invade the Sedge Meadow Stage and lead to Grassland.

The Phragmites-Cyperus Stage

This stage occurs on the banks of streams and rivers and follows the stage of Submerged and Floating Aquatics. *Cyperus textilis* forms small consocieties on the stream banks or occurs as small groups in marginal shallow water. *Cyperus immensus* forms consocieties of larger extent. The grass, *Phragmites communis*, forms characteristic consocieties along riverbanks. All three species may extend into the water. The culms of *Phragmites communis* are elongate and relatively pliable, a character which may be correlated with the periodic inundation during floods which is a feature of the habitat. Debris and sediment deposited by floodwaters are retained by the plants of the *Phragmites-Cyperus* stage and in this way the level of the substrate is built up.

The Stage of Woody Herbs and Shrubs

This stage in the succession follows the *Phragmites-Cyperus* stage. Species include *Miscanthidium capense*, *Cliffortia strobilifera*, *Gomphostigma virgatum*, *Rhus glauca*, and *R. dentata*. This community is seral to either Gully Bush or Riverine Scrub.

In the case of ponds and vleis the stage of Woody Herbs and Shrubs is not represented; the Sedge Meadow Stage is seral to Grassland.

The Subsera

This category refers to the succession on secondary bare areas. The principal causal agent of such bare areas is man, by the direct and indirect effects of his activities. Localities include quarries, roadsides, waste urban ground, stock enclosures and fallow land.

With the exception of abandoned quarries, which may be colonised by lichens, disturbed ground is colonised by flowering plants. The primary invaders are prostrate and decumbent annuals such as *Richardia scabra*, *Aizoon glinoides*, *Tribulus terrestris*, *Chloris virgata*, and *Eleusine indica*. These are followed by suffrutices and half woody herbs such as *Monsonia ovata*, *Argemone mexicana*, *Plantago lanceolata*, *Oenothera biennis*, *Rumex caudatus*, *Bidens pilosa*, *Xanthium pungens*, *Senecio pterophorus*, and grasses such as *Eragrostis curvula*, *Sporobolus capensis*, and *Chloris gayana*. On fallow land, *Acacia karroo* appears at this stage in the succession and leads to the formation of Woodland. An area of former Grassland which had been under crops and then left out of cultivation for ten years was observed to have a field layer of *Sporobolus capensis*, *Eragrostis curvula*, *Digitaria eriantha*, and patches of *Cymbopogon marginatus*, in which were scattered specimens of *Acacia karroo* (about eight feet in height).

Cynodon dactylon is an early and valuable invader and frequently becomes dominant in areas such as roadsides and cattle enclosures.

A feature of the flora of disturbed ground is the high proportion of aliens. Further, these aliens are confined to disturbed ground and do not extend into adjacent communities of indigenous vegetation. The limiting factor would appear to be competition. The flora on disturbed ground is of economic value inasmuch as it binds the soil and retards soil erosion.

The flora of land devoted to plantations, pastures and annual crops is in general alien and artificially controlled, that is, there is no natural succession. For further discussion of this flora see Section 6 on Aliens.

2. GRASSLAND

Synonymy: Dyer (1937): Grassveld; Adamson (1938): Dry Grassland, Moist Grassland; Story (1952): Sweetveld, Sourveld, Macchia (in part); Acocks (1953): Eastern Province Thornveld, Northern or Typical Form; Martin & Noel (1960): Temperate Savannah Sub-formation, *Acacia* Grassland type (in part).

Grassland (referred to commonly as "Grassveld" in South Africa) is distributed predominantly in the King William's Town district in the midlands on the plateaux, including, the native locations west of King William's Town to the Tamara Heights and from Mngqesha to Sittingbourne, the Berlin-Pelton area, the plateau above the Kubusi valley (extreme northern sector of the map); in the East London district, the Mooiplaas and Paardekraal native locations, a section of Released Area 33, a belt just inland of the Coast Dune Bush from the Kiwane River to the Gulu River, and the plateau in the Newlands Location-Macleantown area.

The Grassland falls into two categories, the Sweetveld and the Sourveld. These are broad relative terms without precise scientific definition, but of common usage in South Africa. They refer to palatability: whereas Sweetveld remains palatable during winter and will maintain stock in good condition, Sourveld is palatable in spring and early summer only (Scott, 1955; Rattray, 1957). The grazing value of Sourveld decreases progressively during autumn and winter and stock require supplementary feed in addition to the grazing to maintain their condition. Scott (1955) states that the unpalatability of sourveld grasses during winter may be linked with high fibre content.

The Sourveld occurs on the relatively wet and cool plateaux. The Sweetveld occurs in the relatively dry and warm areas of lower altitudes. Local variations governed by aspect occur; patches of Sweetveld occur on relatively dry and warm north and north-west aspects at higher altitudes and the Sourveld extends to the coast along south and south-west aspects. Story (1952) states that the dividing line between the Sourveld and Sweetveld is between the 25-inch and the 30-inch isohyets and, further (p. 105), that "where the rainfall is between the needs of Sweetveld and Sourveld, a light soil will throw the balance in favour of the Sourveld, and conversely".

The herbage of the Sourveld consists of a dense cover; constituent species include *Elyonurus argenteus*, *Aristida junciformis*, *Themeda triandra*, *Alloterosis semialata* and *Microchloa caffra*.

With incorrect veld management, the proportion of *Themeda triandra* decreases in favour of *Aristida junciformis* and *Elyonurus argenteus*, both unpalatable species, with which are associated *Sporobolus capensis*, *Eragrostis curvula*, and *E. plana*. *Senecio retrorsus* is a common associated herb. *Elyonurus argenteus* tends to predominate over the proportion of associated grasses under heavy grazing in large camps. The accumulation of basal litter is a common feature of this species.

Aristida junciformis tends to predominate at the upper altitudinal range of the Sourveld while *Themeda triandra* tends to predominate at the lower altitudinal range of the Sourveld.

Veld management, with particular reference to burning practices, should be directed towards suppression of *Elyonurus argenteus*, *Aristida junciformis* and associated less palatable species in favour of *Themeda triandra* and the associated more palatable species.

A characteristic grassveld type occurs at the margins of Dry Forest, for example, at Frankfort Hill near Trig. Survey Beacon 2983, and (less extensively) at the margins of Gully Bush, for example, at Kei Road. The community consists of an association of tall robust grasses (*Miscanthidium capense*, *Cymbopogon validus*, *Setaria sphacelata*) together with geophytes (*Watsonia meriana*, *Agapanthus* sp.) and woody herbs (*Pteridium aquilinum*, *Leonotis leonurus*, *Argyrolobium polyphyllum*, *A. sericeum*, *Tephrosia grandiflora*). This community is best developed in the First Order Ecotone between the upper margin of Forest and Grassland.

The herbage of Sweetveld consists of an association of *Themeda triandra* and *Hyparrhenia hirta*. *Themeda triandra* is dominant during spring and early summer; *Hyparrhenia hirta* is dominant during late summer and autumn. Due to incorrect veld management, this association has been reduced in extent (being at present represented mainly within railway reserves) and changed to a bewildering variety of forms.

An indication of incorrect veld management is a reduction in the relative proportion of *Themeda triandra* and the appearance of such species as *Eragrostis plana*, *Sporobolus capensis*, *Aristida junciformis*, *Eragrostis curvula*, and *Cynodon dactylon*. Ultimately, the Grassland is reduced to a short sward ("Lawn" Grassland) in which *C. dactylon* is dominant. Further heavy grazing results, especially in the dry valleys, in total suppression of the grasses in favour of unpalatable shrublets such as *Aster filifolius*, *Pteronia incana* (Plate iii), and *Chrysocoma tenuifolia*. All stages in the retrogression of Sweetveld to an association of unpalatable shrubs may be seen within the Native reserves.

Sweetveld is liable to invasion by *Acacia karroo*. As a result, the terms "Sweetveld" is used in common parlance to refer to either open Grassland or Acacia Woodland (with associated Grassland).

A conspicuous feature of Grassland is the occurrence of associated herbaceous plants, other than grasses, which form an integral part of the community. These associated herbaceous plants are termed "forbs" and fall into two groups, namely, the vernal aspect forbs and the autumnal aspect forbs. The vernal aspect forbs flower and complete their development during spring and early summer; the autumnal aspect forbs flower and complete their development during late summer and autumn.

The majority of vernal aspect forbs possess underground storage organs in which food reserves are available to enable rapid growth and development to take place *before* the spring rains. In this way they are able to flower, set seed, and produce leaves before being overshadowed by the grasses. *Cyrtanthus mackenii* var. *cooperi* is a conspicuous vernal aspect forb on burnt Grassland at the coast. Bayer (1955) states that burning of Grassland promotes early growth of the vernal aspect forbs and that they fail to appear if the cover of dead winter grass is not removed for several years. The characteristic high proportion of forbs in the Grassland of railway reserves (regularly burnt to form "fire breaks"), compared with the low proportion of forbs in adjacent Grassland, would seem to confirm this.

The autumnal aspect forbs are generally taller than the vernal aspect forbs and include woody herbs and shrublets. They do not precede the grasses in time of development. Examples such as *Pteridium aquilinum* and *Watsonia meriana* compete actively with the grasses and suppress them. Autumnal aspect forbs do not occur in open Grassland (in contrast to the vernal aspect forbs) but are restricted to damp situations at forest margins or on terrain strewn with large boulders. Bayer (1955) states that they are killed out by grass burning.

Sourveld which, by incorrect veld management, has deteriorated to a *Sporobolus capensis*—*Eragrostis plana*—*Senecio retrorsus* stage, is liable to invasion by the shrublet *Cliffortia linearifolia* which ultimately becomes dominant. Various stages of the invasion of Grassland by *C. linearifolia* occur above Mngqesha and in the Woodlands Mission area. Patches of this shrub in Grassland occur in damp situations at lower altitudes extending to the coast.

An isolated community of shrublets, all of austral affinity, occurs in Released Area 33 above the Kwani River in *Sporobolus capensis*/*Eragrostis plana* Grassveld. The species include *Erica* sp. probably *E. orientalis* (Comins, 1515), *Eugenia albanensis*, *Agathosma capensis*, *Metalasia muricata* (dwarf form), *Disparago ericoides*, *Aspalathus spinosa*, *Acmadenia juniperina*, and *Senecio concolor*. The wind-shorn growth form of crowns of *Acacia karroo* trees growing in a relatively protected situation just over the brow of the slope suggests that the slope is exposed to strong winds.

Bobartia orientalis occurs in dense patches in Grassland in the midlands and along the coast on mesic south and south-east aspects.

The invasion of Grassland by *Aster filifolius*, *Chrysocoma tenuifolia*, and *Selago corymbosa* may be observed in the vicinity of Zwelitsha, between King William's Town and Breidbach, and on the west slope of the round hill adjacent to the road between the Ciskei Airport and the Yellow Woods River bridge (on the road from King William's Town to Kei Road). *A. filifolius* and *C. tenuifolia* are known to be poisonous to stock and *S. corymbosa* is an unpalatable species.

The History, Management and Utilization of Grassland

A reference to open Grassland appears in a report upon Kaffraria, dated 1 March, 1820, compiled by Lieutenant Ives Stocker (Theal: 1902, 56) as follows: "In particular parts fine rich plains present themselves, covered with verdure, and, except being interspersed with an occasional clump of bush, are entirely open". The map prepared by Jervois (1847) portrays a "tract of open country" in the Peelton-Kings Cross-Berlin area and "open country, devoid of bush" on the intervalley plateaux. It would appear from these early reports that the present pattern, of open Grassland on the plateaux of the midlands and Woodland in the drainage courses of the valley complex, has persisted for at least a century.

Grazing and burning practices constitute the most important factors in the management of Grassland. Management must be directed at maintaining the Grassland at the stage in the succession at which *Themeda triandra* is dominant and the carrying capacity is at a maximum. The primary requirement is the provision of a sufficient number of paddocks of suitable size, with adequate watering points, to facilitate the application of a system of rotational grazing. Lack of application of this principle to commonages and native reserves has resulted in deterioration of the Grassveld and consequent reduction in carrying capacity. A system of rotational grazing must be based on consideration of the critical growth periods (spring growth, and autumn seeding and storage of food reserves) of the desirable plant species. The ratio and number of cattle and sheep per grazing unit must be controlled bearing in mind the fact that, under natural conditions, the vegetation supported a wide variety of indigenous herbivores (selective and non-selective grazers as well as browsers).

Invasion of the Grassland by *Acacia karroo* is widespread and linked with the deterioration of the grass cover due to incorrect veld management. *A. karroo* is a precursor to Scrub which eventually replaces the Grassland. It should be noted that the suggestion that the present areas of Grassland may represent former Scrub cleared by the Bantu is not tenable (Story, 1952).

Bobartia orientalis and *Cliffortia linearifolia* are unpalatable species; their presence in Grassland therefore reduces the carrying capacity. It has been observed that the fence of a railway reserve may separate a dense patch of *B. orientalis* (outside the reserve) from *Themeda-Hyparrhenia* Grassland with associated forbs (within the reserve). The fact that the Grassland within the railway reserve is burnt regularly and not grazed, and that *B. orientalis* does not occur there, indicates that the density of *B. orientalis* in Grassland is correlated with veld management.

The retrogression of large areas of Grassland within the native reserves to a *Cynodon* "lawn" is of interest as it has a direct bearing on the pastoral economy of such areas. Controlled grazing has been introduced on all Trust-owned land and in the planned locations.

Bews (1927) observes that nothing else has had a greater influence on the general course of evolutionary history among flowering plants, as well as among the higher animals, than the fact that so much of the total surface of the globe had become completely dominated by grasses. The importance of judicious management of Grassland cannot be overlooked. Bayer (1955, 550) states that "Whether civilisation in South Africa survives or not will be determined by the way we manage our grasslands".

3. WOODLAND

This category refers to vegetation which is composed essentially of woody plants (Schimper, 1903). The dominants are either shrubs or trees. Herbs are represented in the field layer.

(a) *Acacia Woodland*

Synonymy: Dyer (1937): Scrub (in part), Grassland (in part); Adamson (1938): Temperate Savannah; Story (1952): *Acacia* Scrub; Acocks (1953): Eastern Province Thornveld, Southern Form (in part); Martin & Noel (1960): Temperate Savannah Sub-formation, *Acacia* Grassland type (in part).

A widespread feature in the survey area is the invasion of Grassland by *Acacia karroo*. This leads to the establishment of two distinct types of *Acacia* Woodland, a Parkland type and a Scrub type.

The Parkland type of *Acacia* Woodland, which consists of *Acacia karroo* trees scattered in Grassland (Plate 4), occurs mainly in the north-east sector of the area (east of the road running from Amabele to Kei Road to Maclean-town to the Gonubie River). Small patches occur in the vicinity of King William's Town and at the confluence of the Noncampa, Rhayi, and Ngxwalane native locations. Here the community is frequently masked by a secondary invasion of *Acacia karroo*. The pasture is not suppressed by the invading trees; any destruction of the herbage is due to trampling by stock seeking shade. It appears that the invasion by *Acacia karroo* takes place within a single season; the trees being remarkably uniform in size, suggesting that they approximate closely in age. The dynamics of this invasion of the Grassland by *A. karroo* to form a Parkland type of Woodland is not clear, but it would seem that it is a natural process and not attributable to incorrect veld management. Scott (1951) states that the ideal grazing is obtained under parklike conditions where there is plenty of shade but not enough density of trees or shrubs to diminish the grass growth.

In the Scrub type of *Acacia* Woodland the trees of *Acacia karroo* are, in comparison with the Parkland type of Woodland, distributed in a denser pattern in the Grassland.

The Scrub type of *Acacia* Woodland occurs throughout the complex of valley systems, wherever the Grassland has been subjected to incorrect veld management. This is a noticeable feature on commonages and in the vicinity of urban areas such as King William's Town, Macleantown, Berlin, Kei Road, Mooiplaas, Frankfort, and Debe Nek. The community is well represented in a portion of Released Area 33 and to the north-west of Kidd's Beach; smaller areas occur between the Gonubie River valley and the Kwelera River valley. The community frequently occurs as a belt of varying width between Scrub and open Grassland. This belt may be extensive or relatively narrow; the narrow belts of *Acacia* Woodland (Scrub type) do not appear on the vegetation map as they have been obliterated by reduction in scale. Encroachment also occurs on abandoned cultivated lands. The trees are remarkably uniform in size. If there has been a secondary invasion the community exhibits two canopy layers, each fairly uniform in height.

The trees of *Acacia karroo* serve as foci for the establishment of a wide variety of sequents to form a pattern of "bush clumps" separated by glades. The "bush clumps" coalesce to form Scrub.

(b) *Scrub*

Synonymy: Dyer (1937): Inland Scrub, Karroid Scrub; Adamson (1938): Succulent Scrub; Story (1952): Fort Cox Scrub, Nqhumeya Scrub; Acocks (1953): Valley Bushveld (in part), Fish River Scrub (in part); Martin & Noel (1960): Warm Temperate Forest Scrub, Sub-succulent Woodland Sub-formation, Low Succulent Scrub Sub-formation (in part), Temperate Savannah Sub-formation (Bush Clump Savannah type, Dry Temperate Savannah type).

This community consists of densely packed shrubs with associated climbers and small trees.

Scrub is the most extensive and widespread of the plant communities which occur in the area. It is represented to a lesser or greater extent in all localities except in the mountainous north-western sector.

There are two extreme variants, namely the Xeric Scrub of the dry valley slopes and the Mesic Scrub of the moist valley slopes. The latter variant is well represented along the coastal belt.

Although *Acacia karroo* is the most common precursor in the succession to Scrub, this is not invariably the case. Other precursors include *Scutia myrtina*, *Ziziphus mucronata*, and *Randia rudis*.

The following occur in Scrub throughout the area, being represented in all scrub types within the range of the two extreme variants (Xeric Scrub and Mesic Scrub): Herbs: *Panicum deustum*, *Melica racemosa*; climbers: *Aloe ciliaris* (rare), *Thesium triflorum*, *Clematis brachiata*, *Pelargonium peltatum*, *Jasminum multipartitum*; shrubs and small trees: *Schotia afra*, *Fagara capensis*, *Ptaeroxylon obliquum*, *Phyllanthus verrucosus*, *Rhus longispina*, *Hippobromus pauciflorus*, *Ziziphus mucronata*, *Scutia myrtina*, *Grewia occidentalis*, *Scolopia zeyheri*, *Dovyalis tristis*, *Cussonia spicata*, *Plumbago capensis*, *Royena lycioides*, *R. simii*, *Putterlickia verrucosa*, *Olea africana*, *Carissa bispinosa*, *Ehretia rigida*, *Lantana rugosa*, *Lippia javanica*, and *Randia rudis*.

The Xeric Scrub of the hot, dry valley slopes (e.g. Line Drift, Ebb and Flow) exhibits a marked development of succulence and spinescence. *Euphorbia tetragona* (Plate v), *E. triangularis* and—to a lesser extent—*E. grandidens* and *E. pentagona* occur, in association with the following: herbs: *Sansevieria thyrsiflora*, *Asparagus denudatus*, *Kalanchoe rotundifolia*, *Crassula expansa*, *Plectranthus hirtus*, *Barleria obtusa*, *Blepharis dilatata*, *Peristrophe caulopsila*; climbers: *Cissus cirrhosa*, *Azima tetracantha* (not common, due to overgrazing), *Sarcostemma vininale*; shrubs and small trees: *Portulacaria afra*, *Capparis oleoides*, *C. citrifolia*, *Maytenus cymosus*, *M. capitatus*, *M. undatus*, and *Euclea undulata* (rare). *Aloe ferox* occurs on open ground together with *Aloe tenuior* var. *decidua*, *Cotyledon orbiculata*, *Pteronia incana*, *Aster filifolius*, and *Chrysocoma tenuifolia*. At the coast, Xeric Scrub in which *Aloe ferox* is dominant, occurs only on hot dry slopes above rivers, for example, the Kwelegha River and the Gonubie River.

The Mesic Scrub of the moist valley slopes (e.g. between Fort Jackson and Cambridge) represents a more advanced stage in the succession to closed Woodland. *Aloe ferox* and *Portulacaria afra* do not occur. There is a well-developed field layer including *Haemanthus albiflos*, *Dietes grandiflora*, and *Isoglossa ciliata*. Shrubs and small trees include *Crotalaria capensis*, *Erythrina humeana*, *Halleria lucida*, *Canthium inerme*, *C. obovatum*, and *Brachylaena elliptica*.

Tree species, including *Podocarpus falcatus*, *Calodendrum capense*, *Harpephyllum capense*, *Encephalartos altensteinii* (at Kei Road) and *E. villosus* (at Fort Grey), invade the Mesic Scrub to form Gully Bush.

A "bush-clump" community occurs on dolerite outcrops in the Laing Dam-Mount Coke area (see under Lithosere). The dolerite outcrops appear to provide some protection from grass fires. Shrubs and trees which occur on the dolerite outcrops include *Royena cordata*, and *Randia rudis* (both with "cushion" growth form), *Scutia myrtina* (scrambler or shrub), *Acacia karroo*, *Schotia latifolia*, *Harpephyllum caffrum*, *Pterocelastrus tricuspidatus*, *Apodytes dimidiata*, *Scolopia ecklonii*, *Cussonia spicata*, *Rapanea melanophloeos*, and *Olea africana*.

A Scrub community in which *Royena simii* is dominant occurs within the native reserves. A well-developed example may be seen within the catchment area of the Ngqokweni River, north-west of King William's Town. The individual shrubs of *Royena simii* (with a characteristic dome-shaped growth form due to browsing by goats) occur scattered in Grassland either together with scrub species, or more commonly, as a consociates.

A "topiary" type of Scrub, which occurs in the native reserves, consists of scattered specimens of *Randia rudis* and *Scutia myrtina* which are grazed by goats into a dense conical growth form. *S. myrtina* eventually grows taller than the goats can reach and then grows into an hour-glass shape. Palatable grasses such as *Panicum maximum* grow in the shelter of these shrubs where they are protected from the goats. Extensive Scrub of this type occurs within the Newlands Native Reserve.

(c) Gully Bush and Riverine Bush

Synonymy: Gully Bush: Dyer (1937, 78): Stream-bank Bush; Story, (1952): Zanyokwe Bush; Comins (1953); Martin & Noel (1960): Warm Temperate Forest Sub-formation, Coastal River-fringing Scrub.

Riverine Bush: Martin & Noel (1960): Inland River-fringing Vegetation.

Gully Bush occurs along drainage courses, from the coast through the midlands to the foot of the Pirie mountains. This community is well represented on the slopes of the watershed which runs between Trig. Beacon 1588 (Bekruipkop) via Needs Camp and the Goolah Ridge to Fort Grey, within the Buffalo River valley between East London and Mount Coke, and along tributary drainage courses in the Keiskamma River valley and the Gonubie River valley.

On the banks of estuaries and upstream within the tidal flow, *Mimusops caffra* and *Harpephyllum caffrum* occur together with *Euphorbia tetragona*, *E. triangularis*, *Protorhus longifolia*, *Schotia afra*, *Cussonia spicata*, and *Acacia caffra*, to form a characteristic river-bank community. White, Dyer & Sloane (1941, 894) suggest that the salinity of coastal rivers "may supply an equivalent of the drought conditions which in some measure the trees [of *Euphorbia* spp.] would be expected to require". *Encephalartos altensteinii* occurs on the east bank of the Keiskamma River estuary. *Strelitzia angusta* is common on steep rocky banks. Climbers include *Aloe ciliaris*, *Behnia reticulata*, and *Senecio angulatus*. The field layer is sparse and includes *Panicum maximum*, *P. deustum*, *Haemanthus albiflos*, *Strelitzia reginae*, *Crassula multicaeva*, and *Plectranthus hirtus*.

Further upstream, beyond the influence of the tide, the community becomes more diversified in number of species. All the species listed under Scrub (with the exception of those species characteristic of Xeric Scrub) occur. In addition the following species occur: herbs: *Pleopeltis lanceolata* (epiphyte on *Encephalartos altensteinii*), *Pellaea viridis*, *Asplenium splendens*, *Panicum maximum*, *Adiantum capillus-veneris* (rare), *Ficinia striata*, *Haemanthus albiflos*, *H. magnificus*, *Pelargonium inquinans*, *P. odoratissimum*, *Hypoestes aristata*, *Echolium flanaganii*, *Isoglossa eckloniana*, *Justicia bowiei*; climbers: *Dioscorea cotinifolia*, *D. rupicola*, *Cissampelos torulosa*, *Entada spicata*, *Scutia myrtina*, *Cissus schlechteri*, *Azima tetracantha*, *Secamone frutescens*, *Marsdenia dregea*, *Vernonia anisochaetoides*, *Senecio deltoideus*, *S. angulatus*; shrubs and trees: *Encephalartos altensteinii*, *Podocarpus falcatus*, *Phoenix reclinata*, *Aloe pluridens*, *Strelitzia reginae*, *Ficus craterostoma*, *Schotia latifolia*, *Erythrina caffra*, *Calodendrum capense*, *Vepris undulata*, *Clausena anisata*, *Commiphora caryaefolia*, *Harpephyllum caffrum*, *Rhus dentata*, *R. legatii*, *R. lucida*, *Maytenus peduncularis*, *M. acuminatus*, *M. mossambicensis*, *Putterlickia verrucosa*, *Pterocelastrus tricuspidatus*, *Dombeya dregeana*, *Ochna arborea*, *Scolopia mundtii*, *Trimeria grandifolia*, *Olinia acuminata*, *Englerodaphne leiosiphon*, *Combretum kraussii* (rare), *Syzygium cordatum*, *Cussonia kraussii*, *Heteromorpha arborescens*, *Royena pubescens*, *R. villosa*, *Olea capensis* subsp. *capensis*, *Azima tetracantha*, *Acokanthera spectabilis*, *Tecomera capensis*, *Burchellia hualina*, *Gardenia globosa*, *G. thunbergia*, *Canthium ciliatum*, *C. obovatum* and *Pavetta lanceolata*.

A well-developed type of Gully Bush occurs in the Buffalo River valley at Fort Grey and Fort Pato. The average height of the trees is about 25 feet and the maximum height is about 55 feet. *Umtiza listerina* occurs in association with *Nuxia congesta*, *Cassine croceum*, *Notobuxus macowanii*, *Ptaeroxylon obliquum*, in addition to the other Gully Bush species listed above. The canopy is closed and there is a sparse field layer in which *Encephalartos villosus* is conspicuous.

Gully Bush represents an advanced stage in the succession to Forest. With the gradual closing up of the canopy (Plates vi and vii) and consequent elimination of heliophilous species (such as *Euphorbia* spp.), the community changes to form Dry Forest.

Riverine Bush occurs on graded reaches of the Buffalo River (King William's Town to Braunschweig area) and the Yellow-woods River (Peelton area). The community consists of an open association of trees distributed along the river banks (Plate viii). *Combretum erythrophyllum*, *Acacia caffra*, and *Podocarpus falcatus* occur in association with (introduced) *Salix babylonica* and *Eucalyptus* sp. A field layer may be represented in the form of introduced weeds (*Datura stramonium*, *Nicotiana glauca*, *Xanthium pungens*), and *Setaria chevalieri*.

(d) Coast Dune Bush

Synonymy: Dyer (1937): Littoral Scrub; Acocks (1953): Dune-forest; Martin & Noel (1960): Coastal Woodland.

The stabilised sand-dunes, which are distributed parallel with the beach in a continuous strip along the coast (except where interrupted by river mouths), are fixed and held by Coast Dune Bush.

The herb community of the Psammosere is invaded by woody shrubs, including *Passerina rigida*, *Eugenia capensis*, *Carissa bispinosa*, *Maytenus procumbens*, *Osyris compressa*, *Turraea obtusifolia*, and *Metalasia muricata*, supporting the climbers *Clematis brachiata*, *C. triloba*, and *Rubia cordifolia*.

This community is in turn invaded by the trees *Mimusops caffra*, *Brachylaena discolor* and *Tarchonanthus camphoratus*.

The area to the leeward of the above (extending down the leeward slope of the fixed sand dunes), which is protected from the effects of salt spray, is invaded by a wide variety of species. Viewed from the base of the leeward slope, there is a marginal zone of shrubs and climbers which are seral to trees. The latter attain a height of 30 to 40 feet. The following species occur: herbs: *Panicum deustum*, *Ehrharta erecta*, *Veltheimia viridifolia* and *Haemanthus albiflos*; climbers: *Asparagus racemosus*, *Behnia reticulata*, *Clematis brachiata*, *Scutia myrtina* (scrambler or shrub), *Cussonia thyrsiflora*; shrubs and trees: *Ficus capensis*, *Rhoiacarpos capensis*, *Osyris compressa*, *Fagara capensis*, *Clausena anisata*, *Turraea obtusifolia*, *Rhus crenata*, *R. glauca*, *R. incisa* var. *obovata*, *Maytenus cymosus*, *M. procumbens*, *Putterlickia pyracantha*, *Cassine sphaerophylla*, *C. tetragona*, *Allophylus natalensis*, *Deinholia oblongifolia*, *Dovyalis lucida*, *Sideroxylon inerme*, *Mimusops caffra*, *Royena cordata*, *Euclea multiflora*, *Maba natalensis*, *Acokanthera venenata*, *Ehretia rigida*, *Cestrum laevigatum* (alien), *Pavetta revoluta*, *Brachylaena discolor*, *Tarchonanthus camphoratus* and *Metalasia muricata*. *Loranthus dregei* and *L. quinquenervis* occur as parasites.

Mimusops caffra and *Brachylaena discolor* are characteristic species of the seaward slope of the fixed sand dunes. There they are exposed to wind-borne salt spray and occur in dwarf or "clipped hedge" form. On the leeward slope of the fixed sand dunes they attain full development and size.

(e) Forest

In this Woodland type the trees grow in a closed condition. Forests occur on the slopes of the Pirie mountains, where the climate is relatively cool and moist.

Forest may be divided into two sub-types, Dry Forest and Moist Forest.

Dry Forest

Synonymy: Dyer (1937): Inland Scrub (in part); Story (1952): Dry Forest; Martin & Noel (1960): Temperate Rainforest Transition Scrub.

Dry Forest is distributed on the western slopes of the Pirie mountains roughly below the 2,500-foot contour from Mngquesha north-east to Amabele.

The height of the canopy is roughly 55 feet, with emergents such as *Podocarpus falcatus*, *Calodendrum capense* and *Clerodendrum glabrum* attaining a height of 70 feet. There is a well defined marginal community, including: herbs: *Stipa dregeana*, *Hypoestes triflora*; shrubs: *Clusia pulchella*, *Trichocladus ellipticus*, *Acokanthera venenata*, *Rapanea melanophloeos*. There is often an abundant regrowth of *R. melanophloeos*; this species is resistant to grass fires and affords some protection to the Forest. Less common marginal species include *Podocarpus latifolius*, *Dais cotinifolia*.

Gardenia neuberi, *Grumilia capensis*, *Strychnos henningsii* and *Vepris lanceolata*. The epiphytes *Usnea* sp. and *Mystacidium flanaganii* are common on marginal shrubs and emergent trees. Owing to the shade cast by the closed canopy the field layer is sparse or altogether suppressed. Along rocky drainage courses, where sunlight penetrates, herbs such as *Pellaea viridis*, *Asplenium splendens*, *Panicum maximum*, *Cyperus striata* and *Streptocarpus rexii* occur.

Encephalartos altensteinii, a common species in Gully Bush, does not occur in Dry Forest. The suppression of *E. altensteinii* in localities where the succession has progressed from Gully Bush to Dry Forest (e.g. at the Nkwebu River on the road from Kei Road to Frankfort) appears to be due to the increased shade cast by the relatively dense canopy of Dry Forest.

Cut-over Forest

This category refers to areas formerly covered by Dry Forest and at present covered by a relic community consisting of a discontinuous canopy of trees and shrubs. The degeneration which has taken place is due to the felling of trees for timber and fuel and the trampling of seedlings by stock. There is also a certain amount of destruction of shrubs (particularly the unarmed species) by browsing. The removal of sections of bark from forest trees by natives for use as medicinal remedies and the practice of setting fire to the heartwood when robbing honey, are contributory causes in the destruction of forest species.

A marked feature is the absence of a definite and continuous marginal community between the Cut-over Forest and the Grassland.

Protection of Cut-over Forest from trampling by stock results in the establishment of a marginal community consisting of *Rapanea melanophloeos* which effectively protects the forest species from destruction by fires originating in the Grassland. *R. melanophloeos* provides shelter and protection for the establishment of other marginal species such as *Scutia myrtina*, *Apodytes dimidiata*, *Rhannus prinoides* and *Burchellia bubalina*. Within the Forest, protection from trampling and browsing by stock results in the establishment of forest species such as *Calodendrum capense*, *Podocarpus falcatus* and *Celtis africana*.

Areas of Cut-over Forest should be fenced off and protected from grass fires, grazing, trampling, and felling. Such areas would then revert to Dry Forest.

Moist Forest

Synonymy: Dyer (1937): Low Forest (in part); Adamson (1938): Temperate Forest; Story (1952): Moist Forest; Acocks (1953): Dohne Sourveld (in part); Martin & Noel (1960): Temperate Rainforest Sub-formation.

Moist Forest occurs above roughly the 2,500 ft. contour in the Evelyn Valley area and north of the Upper Izeleni area. It has its origin along drainage courses within areas of Dry Forest. The taller trees occur along drainage courses, from which locality the species typical of Moist Forest invade the surrounding Dry Forest. This explains the occurrence of a "marginal community" of Dry Forest relative to the Moist Forest. The "marginal community" of Dry Forest may be relatively narrow (as at the upper Forest margin of higher altitudes) or relatively broad (as at the lower Forest margin of lower altitudes).

Podocarpus falcatus, *Olea capensis* subsp. *capensis* and *Xymalos monospora* are the dominant trees. *Podocarpus latifolius* is not so common as *P. falcatus* and occurs on drier ground. *Cunonia capensis* is a characteristic species at the upper forest margin adjacent to *Protea* Veld. *Lycopodium clavatum*, *L. verticillatum*, and *Selaginella kraussiana* are characteristic field layer species. The ferns *Asplenium rutaefolium*, *A. spendens*, *Polypodium ecklonii* and *Vittaria isoetifolia* occur as epiphytes on the boles of forest trees.

Saplings of *Trichocladus ellipticus* form dense associates in the undergrowth particularly where felling has occurred. Story (1952, 69) states, with reference to Moist Forest in the Keiskammahoek district, that "A peculiar feature of these forests is the enormous quantity of *Trichocladus ellipticus* in them". Sim (1907, 220) described it as "abundant in the Amatola Forests" and (quoting from the Catalogue of Exhibits, Indian and Colonial Exhibition, 1886) as "A valuable underwood in the Amatola mountain forests. Little else is cut from the forests for the firewood supply of King William's Town". In Evelyn Valley within an area of 1,000 square feet, of 77 tree and shrub species listed a total of 24 (31 per cent) consisted of slender trees of *T. ellipticus* of a circumference in excess of one inch at breast height; there were, in addition, 36 saplings of *T. ellipticus* of a circumference of less than one inch at breast height.

Under the prevailing optimum conditions the trees attain maximum development. Felling permits indicate that *Podocarpus* spp. reach a height of between 70 and 90 feet with diameters (at breast height) ranging from two feet to five feet. One specimen of *Podocarpus falcatus* was felled which measured 113 feet in height with a diameter (at breast height) of five feet two inches.

The trees exhibit a marked uniformity of certain growth-form characteristics such as smooth boles (frequently with plank buttresses) and rounded crowns bearing evergreen simple leaves. These features indicate the tropical affinity of the species concerned (Bews, 1927, 64). Plank buttresses are a feature of *Calodendrum capense*, *Olea capensis* subsp. *capensis* and *Ficus capensis*. Exceptions to the evergreen habit are *Celtis africana*, *Calodendrum capense*, *Erythrina caffra*, *Ficus capensis*, and *Rhus legati*, which are regularly deciduous, and *Ptaeroxylon obliquum*, which is deciduous in dry seasons. Although most species bear simple leaves, there are notable exceptions including *Fagara capensis*, *Ptaeroxylon obliquum*, *Rhus legati*, *Vepris lanceolata*, *Cussonia spicata* and *Cunonia capensis*. These exceptions emphasize that the Moist Forest of the area is related to but not identical with the primitive forest of moist tropical regions described by Bews (1927). Spinosity is confined to *Fagara capensis*, *Erythrina caffra*, and *Scutia myrina*; this lack of spinosity in Moist Forest is in strong contrast to the high development of spinosity in Scrub and Gully Bush.

Owing to the moist conditions, saprophytic fungi are plentiful and there is a rapid breakdown of dead wood to form a surface layer of humus. The field layer includes a wide variety of herbs including *Lycopodium clavatum*, *Selaginella kraussiana*, *Pteris cretica*, *Cheilanthes bergiana*, *Asplenium lunulatum*, *Polygala confusa*, *Diclis reptans*, *Streptocarpus rexii* and *Galopina circaeoides*. *Zantedeschia aethiopica* and *Carex petitiiana* occur in damp open situations. A characteristic feature is the wide variety of plants which grow on trees and boulders, including *Usnea* sp., *Lycopodium gnidioides*, *Hymenophyllum tunbridgense*, *Pleopeltis lanceolata*, *Angraecum conchiferum*, *Peperomia reflexa* and *Streptocarpus rexii*. *Cyathea capensis* occurs in shade along stream banks.

4. PROTEA VELD

Protea Veld occurs at the upper margin of the forests of the Pirie mountains, between the Forest and the Grassland, at Artillery Glade and above the Forest to the north of Frankfort. This is the least extensive of the plant communities of the survey area.

The dominant plant is *Protea multibracteata*, which grows in association with *Miscanthidium capense*, *Cymbopogon validus*, *Watsonia meriana*, *Pteridium aquilinum*, *Cliffortia linearifolia*, *Buchenroedera multiflora* and *Syncolostemon densiflorus*.

The constituent plants of *Protea* Veld are unpalatable to stock. Although of great academic interest, this vegetation type is of minor economic important in this area.

5. THE HISTORY, MANAGEMENT AND UTILIZATION OF WOODLAND

The following information is contained in an Annual Report of the Department of Forestry (Union Government: 1931, 17):—

“The forests . . . suffered severely during the Kaffir wars and the advance of the white man. It was not until 1859 that the Herbage and Forest Act was promulgated ‘for more efficiently preventing the unlawful cutting down or otherwise destroying the Forests and Herbage in this Colony.’ . . . Owing to various difficulties, however, burning and wasteful felling of timber in the Eastern districts continued for many years, and in 1877 the Forest Rangers reported great damage to the forests, more particularly at the Katberg and along the Amatola mountains. . . .

“Prior to this period [c. 1880] . . . many of the more accessible forests had been exploited to a considerable extent. Large quantities of timber, chiefly Yellow wood (*Podocarpus* sp.) and Sneeze-wood (*Ptaeroxylon obliquum*), had been felled . . . and from the Fort Grey forests . . . large quantities of Saffraan [*Cassine croceum*] had been removed. . . .

“As a result of the indiscriminate working . . . many forests were encumbered with felled wood, lying about on every side. There were no recognised boundaries, and the forests were trespassed and encroached upon from every direction for cultivation purposes. . . .

“In 1885 a Forestry Commission was appointed by the Government to demarcate the forests and to settle disputes affecting them, and three years later the Forest Act No. 28 of 1888 was passed and Regulations were gradually brought into force which made provision for better control of the forests.

“The oldest Government plantation to be seen to-day [1931] is about three acres of gum [*Eucalyptus* sp.] and pines [*Pinus* sp.] which were planted near the Buffalo River at Fort Grey . . . during 1884.”

Subsequent to the passing of the Forest Act of 1888 the official policy has been based on a concept of working the forest areas according to their annual yield in perpetuity. The importance of keeping the Forests of the Pirie watershed and the Gully Bush of the drainage courses in a stable condition cannot be emphasized too strongly. It is fortunate that the greater portion is under the control and correct administration of the Department of Forestry. The same cannot be said of much of the Woodland

within the native reserves (Plate ix) where encroachment of *Acacia karroo* is widespread and destruction of existing Woodland has resulted in the formation of Cut-over Forest.

The invasion of Grassland by *Acacia karroo* to form a Parkland type of Woodland appears to be a natural process, sharply distinct from the formation of a Scrub type of Woodland. The latter is seral to Scrub and represents a stage in a process whereby the carrying capacity, and therefore the economic value, of the veld is reduced. The presence of *Acacia* Woodland (Scrub type) is therefore an indication of incorrect veld management; methods of eradication of *Acacia karroo* together with correct methods of grazing management must be applied to such areas. Evidence obtained from residents and from the comparison of aerial photographs indicates that Scrub has encroached into Grassland at least within the last fifty years.

West (1947) recommends controlled burning in combination with a deferred system of grazing management where bush encroachment is a feature of the vegetation. Methods of eradication of *Acacia karroo*, which are being applied in the survey area, include ring-barking and felling with or without the application of herbicides such as Arsenite of Soda, Diesoline, Diesel Fuel, and Oil Sludge. Ring-barking is claimed to be effective if applied between February and April and only to trees which are more than about five feet in height; the trees are reported to take about twelve months to die. Arsenite of Soda [cost: R10.75 (£5. 7s. 6d.) per 100 lb] is applied as a solution (8 lb to 4 gal of water) to the cut surface after the tree has been felled at about five inches from soil level. The treated stump is covered with the brushwood to keep stock away from the poison. Coppice shoots are formed and the stump subsequently dies. The disadvantage of this method is the toxicity of the poison which is a hazard to stock. Diesoline is claimed to be 90 per cent effective when sprayed through a nozzle (using a pressure pump) round the base of the trunk using about one cup per tree. Diesel fuel is claimed to be more effective than Diesoline as it has a thinner consistency giving better penetration. The method of application consists of making irregular cuts in the bark of the trunk to a height of about one foot above soil level, after which a depression of about half an inch in depth is made in the soil round the base of the trunk and the fuel is applied thickly on the cut surface and allowed to fill the depression. This method is claimed to be 100 per cent effective; there is no subsequent coppicing and the trees dry and eventually collapse after attack by wood borers. Diesel fuel is relatively expensive and Oil Sludge promises to be a much cheaper method of control. Naude & Serfontein (1956) recommend the use of a solution consisting of 12½ oz of 2, 4, 5-T acid dissolved in 10 gallons of Diesoline.

Occasional groups of thorn trees which appear to have died from some natural cause have been observed. The wood had been attacked by a borer but the actual cause of death was not ascertained. Similar cases have been observed by an Officer of the Division of Entomology at Alice. Within the survey area the affected trees are limited to a few contiguous specimens and the effectiveness of this biological control of *Acacia karroo* is negligible.

The feature of Scrub in juxtaposition with open Grassland at the line of a boundary fence is common within the survey area (Plate 10). Two particularly good examples may be seen from the Kei Road–Peelton Road and from the Kei Road–Frankfort Road. In every case, the open Grassland falls within heavily grazed Bantu reserve and the Scrub falls within European-owned land or, less frequently, Bantu-owned land which

is less heavily grazed. The explanation of this correlation appears to lie in the fact that the Bantu reserves are subject, in general, to continuous heavy grazing while the European-owned land is subject to intermittent heavy grazing. Pioneers of *Acacia karroo* do become established within the native reserve land but the seedlings are grazed down with the Grassland on such areas; the seedlings are extremely difficult to locate. Should the heavy grazing pressure be removed from such areas it could be expected that the pioneers of *A. karroo* would grow unchecked and the open Grassland would revert to Scrub. This is an economic factor of the utmost importance in the grazing management of such areas.

Continuous overgrazing of Scrub leads to severe soil erosion. This may be seen in the vicinity of Line Drift and illustrates the inability of Scrub to bind the soil when the field layer is reduced or altogether destroyed. Such areas should be withheld from stock (particularly goats) until the field layer is re-established.

The value of Coast Dune Bush as a "barrier against the encroachment of the sand upon the adjoining lands", the fact that it had been patrolled, and the need to conserve it, were noted by a Forest Officer as early as 1886 (Ricketts, in Cape of Good Hope: 1887, Appendix E to Report No. IV). The Coast Dune Bush has been under Government control since it was demarcated by Government Notice No. 1108 of 1904. The area concerned consists of a fairly continuous narrow strip of approximately 2,700 morgen (5,715 acres).

6. ALIENS

1. Plantations, Crops and Pastures

Extensive Government plantations have been established in the mountainous north-west sector and at Fort Grey. Small plantations and woodlots are not indicated on the map.

The earliest record of afforestation refers to Gums (*Eucalyptus* spp.) and Pines (*Pinus* spp.) planted at Fort Grey by a Forest Officer in 1884. Regular afforestation commenced with the employment of prisoners in planting trees in 1889 (Union Government, 1931).

The relative production of plantations and forests is indicated by the following production figures:—

Pirie Forest Reserve	Timber (cu ft)	Bark (lb)	Mount Coke Forest Reserve	Timber (cu ft)	Bark (lb)
1916/17—			1916/17—		
Plantation.....	3,538	—	Plantation.....	6,584	35,989
Forest.....	25,871	—	Forest.....	6,228	—
1926/27—			1926/27—		
Plantation.....	4,485	12,544	Plantation.....	5,742	—
Forest.....	26,959	—	Forest.....	25,713	—
1936/37—			1936/37—		
Plantation.....	6,854	—	Plantation.....	14,473	—
Forest.....	18,338	—	Forest.....	16,289	—
1946/47—			1946/47—		
Plantation.....	46,244	—	Plantation.....	23,994	—
Forest.....	22,070	—	Forest.....	708	—
1956/57—			1956/57—		
Plantation.....	31,598	16,610	Plantation.....	19,359	151,960
Forest.....	4,535	—	Forest.....	645	—

It will be seen that there has been a progressive increase in quantity of products from plantations and a decrease in quantity of products from forests.

The extent of plantations in 1958 was as follows:—

Mount Coke Plantation.....	352·6 acres (166·6 morgen)
Tamaha Plantation.....	92·2 acres (43·5 morgen)
Pirie Plantation.....	591·1 acres (279·3 morgen)
Cwencwe Plantation.....	1,872·7 acres (884·5 morgen)
Izeleni Plantation.....	779·1 acres (368·1 morgen)

TOTAL.....	<u>3,687·7 acres (1,742 morgen).</u>
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The species cultivated are *Pinus roxburgii*, *P. canariensis*, *Eucalyptus cladocalyx*, *Acacia decurrens* var. *mollis*, and, to a lesser extent, *Pinus patula*, *P. radiata*, *P. caribaea*, *Eucalyptus saligna*, *E. maculata* and *Populus serotina*.

The extent and the variety of crops and pastures in the survey area has been described in detail by Board (In Press). Maize (*Zea mays*) is the most important grain crop, followed by Kaffir Corn (*Sorghum caffrorum*). A total of 72,143 acres was sown to the following grain crops in the season, 1954/55:—

	European-owned Farms (Acres)	Native Reserves (Acres)
Maize.....	23,207	41,276
Kaffir Corn.....	331	2,929
Wheat, Barley Oats and Rye.....	3,583	45,022

Cayenne pineapples (*Ananas sativus*) are cultivated extensively along the coast. In 1955 there were 12,303 acres under pineapples in the East London district and 590 acres under pineapples in the King William's Town district. In the same year there were—in cultivation in the East London district—51,612 guava (*Psidium guajava*) trees, 27,366 citrus trees, and 385 acres under bananas (*Musa* sp.).

The American Aloe (*Agave americana*), Sisal (*A. sisalana* var. *rigida*), and Prickly Pear (*Opuntia* sp.) are planted in the native reserves to form enclosures ("kraals") for cattle.

2. Introduced Plants which have become Naturalised

The Jointed Cactus (*Opuntia aurantiaca*) and Prickly Pear (*Opuntia* sp.) occur in Scrub; *Cestrum laevigatum* occurs in Coast Dune Bush; *Richardia scabra* occurs in Grassland. The Guava (*Psidium guajava*) occurs as an "escape" in Grassland at the coast. The Evening Primrose (*Oenothera odorata*) is common along roadsides. Further examples of introduced plants which have become naturalised are listed in the section dealing with the flora of disturbed ground (Subsere, p. 6).

III. BIOTIC FACTORS

The interrelationship which exists between the plant and animal life of any place is stressed by Warming (1909) and Phillips (1931). Adamson (1938) states that "there is every reason to believe that all vegetation represents a balance between the plants and the physical factors of the environment on the one hand and animals on the other". Together, the plants and animals (including man) form a biotic community.

The wild life of the survey area is less than it was both in numbers and diversity of species. The reduction took place from about the beginning of the nineteenth century (when the country was occupied by Bantu) and was later intensified through the use of fire-arms by Europeans. It appears that all the larger game animals had been destroyed by the middle of the nineteenth century.

Sparrman (Hall, 1934, 75) who travelled in South Africa between 1772 and 1776 observed that a relationship existed between the wild animals and the vegetation. He stated: "It is well known that in feeding they make a more equal division between the grass and the bushes than ordinary cattle do". It would seem that the maladjustment between domestic stock and the natural vegetation lies not only in excessive grazing pressure but also in the nature and degree of selective grazing. Although cattle and sheep do browse on various shrubs and woody herbs (*Schotia afra*, *Acacia karroo*, *Randia rudis*, *Lippia javanica*, *Peristrophe caulopsila*) they are primarily grass-eaters. Goats browse freely on shrubs, woody herbs and grasses alike. Dyer (1930) concludes that goats do browse on shrubs but that as a means of control of *Acacia karroo* any advantage is offset by the fact that they graze down other useful plants as well.

With reference to the encroachment of *Acacia karroo* into Grassland it should be noted that cattle spread the seeds of *A. karroo* and thus aid encroachment; sheep graze the *A. karroo* seedlings down (they are close grazers), hence the importance of the cattle/sheep ratio in any system of grazing management. A combination of cattle and small stock could be expected to make the fullest use of the carrying capacity of the veld, particularly scrub vegetation. These ecological principles have been taken into account with regard to the farm planning and conservation methods at present being applied. These methods are based on principles of rotational grazing and the control of the ratio and number of cattle and sheep per grazing unit. Unfortunately, past practice has, in many instances, consisted of heavy grazing by sheep alone. In scrub areas the grass cover has ultimately been destroyed and only the shrubs and hardy herbs have survived. Such veld has, in turn, been heavily grazed by goats which have destroyed much of the remaining vegetation. In this way, veld, consisting of open Scrub with grassy glades, has ultimately been reduced (in the hot dry valleys) to a relic community of unpalatable species (*Euphorbia* spp., *Aloe ferox*, *Pteronia incana*, *Chrysoconia tenuifolia*) with a greatly reduced carrying capacity.

Kommetjie-veld occurs in the vicinity of King William's Town and represents an interesting example of the ecological dynamics of a biotic community. The term "kommetjie-veld" is derived from the Afrikaans word for a small basin and refers to terrain which consists of a pattern of hummocks and hollows. Story (1952) refers to Debe Hollows, a term based on the Xhosa word indebe, a cup or ladle. Excepting an oblique and doubtful observation by Lieutenant Ives Stocker in 1820 (Theal, 1902),

Backhouse (1844) appears to have been the first to record the phenomenon in 1839. Pickford (1926) ascribes the formation of kommetjie-veld to the activities of earth-worms. It is possible that constant disturbance of the shallow soil layer by the earth-worms may have contributed to the degeneration of the Grassland in such areas. *Themeda triandra* occurs on the hummocks but not in the hollows, where it is replaced by *Sporobolus indicus*, *Eragrostis plana* and *E. curva*.

Birds play an important part in the distribution of seeds of sequent species which occur below specimens of *Acacia karroo* in the development of Scrub from *Acacia* Woodland (Scrub type).

Baboons (*Papio ursinus orientalis*) feed on the fleshy covering of the sporophylls of female plants of *Encephalartos altensteinii*, and cast away the ovules. They also destroy plants of *Aloe ferox* by breaking them down and feeding on the pith.

Man has constituted the biotic factor of greatest impact and effect in the ecology of the survey area. In his report for 1884 the Conservator of Forests (Cape of Good Hope, 1885, Annexure IV) described the destruction of the Evelyn Valley forests by fires which originated in the burning of the Grassland by the natives to provide green pasture for their cattle. Further comments relate to measures taken to prevent the destruction of game in the forests. This policy of the conservation of game in the Government forests has continued to the present day.

The earliest known inhabitants of the King William's Town district were Bushmen (Hammond-Tooke, 1958) and they were finally exterminated by the advancing Bantu in about 1745. The Bantu, who had advanced down the eastern seaboard of the subcontinent, invaded the area from the north-east and their first contact with Europeans took place in 1702 at the Great Fish River (Cory, 1910, 20). From 1702 to 1775 the great westward movement of the Bantu continued. By 1850 the Gqunukhwebi tribe, numbering about 15,000, had occupied the coast country from the mouth of the Fish River almost up to the mouth of the Buffalo River. Occupation of the survey area by Europeans commenced with the establishment of a Mission Station at Mount Coke in 1825. The German military personnel arrived in 1857 and were settled in villages (Braunschweig, Potsdam, Berlin and others). They were followed by the German immigrant settlers who arrived between 1858 and 1859.

The Bantu were hunters and pastoralists; agriculture played only a very small part in their economy. This lack of an agricultural "tradition" is reflected in the cultivation of valley slopes regardless of gradient and contour with subsequent erosion (Plate xi).

Occupation by Europeans introduced extensive livestock farming, cultivation and afforestation. Aliens, such as dodder (*Cuscuta campestris*) and the English sparrow (*Passer domesticus*) were introduced accidentally. Some plants which now occupy extensive areas of former Grassland and Woodland, were introduced intentionally. By far the most important alien element in the present biotic community is domestic livestock (principally cattle and woolled sheep) and in some parts the number of head of livestock in the survey area has been in excess of the carrying capacity of the veld.

There is evidence of an awareness of the need to conserve the remaining indigenous wild life. Many farmers practise wild life conservation on their land. A recent development has been the establishment of official reserves for the protection of fauna and flora. Reserves have been established at Gonubie Mouth (Provincial Gazette, 1955) and at Rooi-krantz (Provincial Gazette, 1956).

By these several means, the occupation of the area by man has had a profound effect upon the composition and distribution pattern of the vegetation.

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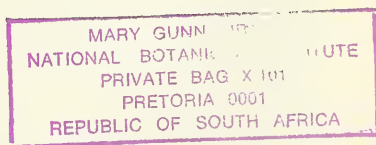




PLATE I.—*Cussonia spicata* on outcrops of dolerite, with *Randia rudis* below. Note "cushion"-type growth form of *Randia rudis* due to browsing by goats. The surrounding Grassland is of the short "lawn" type characteristic of heavily stocked native grazing land. Ten miles from King William's Town on road to Mount Coke. 21st May, 1957



PLATE II.—Halosere at low tide. From left to right: "islands" of *Spartina capensis*, *Arthrocnemum* zone; *Sporobolus virginicus*/*Stenotaphrum secundatum* zone. The bank in foreground and centre distance is Gully Bush on river bank. Hamburg, 1957. bank of Keiskamma River estuary, taken from Keiskamma Hotel. 4th Dec., 1957



PLATE III.—Typical retrogression of the succession in dry river valley due to overgrazing. Relic Gully Bush in gully leading into Keiskamma River: *Calodendrum capense* (in flower), *Harpephyllum caffrum*, *Euphorbia tetragona* and *E. triangularis*. Slopes with *Schotia afra*, *Aloe tenuior* var. *decidua* and *Pteronia incana*. Goats grazing in middle distance. Keiskamma River valley, one mile from Brighton Bridge on road to Sittingbourne. 5th Dec., 1956



PLATE IV.—Middle distance: Gully Bush with *Ficus capensis*, *Encephalartos altensteinii* and *Phoenix reclinata*. Distance: *Acacia* Woodland (Parkland type); *Acacia karroo* scattered in *Themeda*/*Hyparrhenia* Grassland. Farm "Orange Grove", 5 miles from Macleantown. 11th June, 1957



PLATE V.—Xeric Scrub of dry river valley. Valley slopes with sparse scrub community, including *Euphorbia tetragona*, *Acacia karroo*, *Schotia afra*, *Aloe ferox*, *Pteronia incana*; in gullies, relic Gully Bush with isolated specimens of *Calodendrum capense*. Due to destruction of the grass cover by overgrazing, erosion of the soil is taking place. Qawukeni Location, Line Drift. 22nd Jan., 1958



PLATE VI.—Gully Bush; head of gully leading into Gonubie River valley. Storm-water in summer. Species include *Euphorbia triangularis*, *Schotia latifolia*, *Harpephyllum caffrum*, *Cussonia kraussii* and *Encephalartos altensteinii*. Kei Road. 22nd Jan., 1958



PLATE VII.—Gully Bush. Dead tree is *Podocarpus* sp. probably *P. falcatus*. Other species include *Hippobromus alata*, *Trichocladus ellipticus*, *Schottia latifolia*, *Erythrina caffra*, *Scutia myrtina* and *Trimeria grandifolia*. Kei Road; head of drainage course leading into Gonubie River valley. Running water in summer. 22nd Jan., 1958



PLATE VIII.—Riverine Bush with *Phoenix reclinata*, *Combretum erythrophyllum*, *Acacia caffra*. *Themeda/Hyparrhenia* Grassland in foreground. Bridge over Yellow Woods River, 7 miles from King William's Town on road to Hanover. 11th June, 1957



PLATE IX.—Relic of Gully Bush in area occupied by natives; overgrazed Grassland with erosion paths on distant slope; in foreground, drainage course with erosion, *Erythrina caffra* and *Harpephyllum caffrum*. First tree in foreground is *Erythrina caffra* with three small (single frond) plants of *Encephalartos altensteinii* in sward below it. Twenty-three miles from East London on road to Berlin. 5th June, 1957



PLATE X.—European-owned land to left of fence, native-occupied land to right of fence; note contrast in degree of invasion of Grassland by Scrub. Kei Road, watershed between Nahoon River valley and Yellow Woods River valley (left and right of fence, respectively). 22nd Jan., 1958



PLATE XI.—Cultivation of valley slopes in area of native settlement. Cultivated land in foreground; in middle distance, land formerly cultivated and abandoned, showing soil erosion due to lack of vegetation cover. Tamacha, view east from National Road, valley draining into Keiskamma River. 22nd Jan., 1958

